Case

UC EA University Council for Educational Administration

Journal of Cases in Educational Leadership
1–14

DOI: 10.1177/1555458920979838
journals.sagepub.com/home/jel
SAGE

Educational Change by Design: Creating a School of the Future

Lisa G. Wyatt[1], Benjamin S. Scragg[1], Jennifer Y. G. Stein[1], and Punya Mishra[1]

Abstract

This case study, framed within a school–university partnership, highlights the tensions inherent to employing design-based approaches for educational change. The case illustrates core tensions between an abductive, open-ended, design-based approach to change versus more traditional (deductive/inductive) approaches to managing change in schools. The design process serves as a way to break away from the traditional "grammar of schooling" (Tyack & Tobin) in a system unaccustomed to radical change. The case highlights the challenges of maintaining fidelity to the design process within a range of logistical and resources constraints, such as the time available to participants to engage in the process, and the difficulty of rapidly prototyping a new school model within an existing educational ecosystem. In the teaching notes, we recommend a theoretical lens and set of questions for educational leaders to reflect on as they consider approaches to educational change in their own settings.

Keywords

design thinking, educational leadership, school–university partnership

Introduction and Background

This case study, framed within a school–university partnership, highlights the tensions inherent in bringing design-based approaches to educational change. Specifically, we describe a design partnership between a high-functioning school district and a college of teacher education at a local university, as the two worked together to create a school

[1]Arizona State University, Tempe, USA

Corresponding Author:
Benjamin S. Scragg, Mary Lou Fulton Teachers College, Arizona State University, 1050 S Forest Mall, Suite 430A, Tempe, AZ 85281, USA.
Email: bscragg@asu.edu

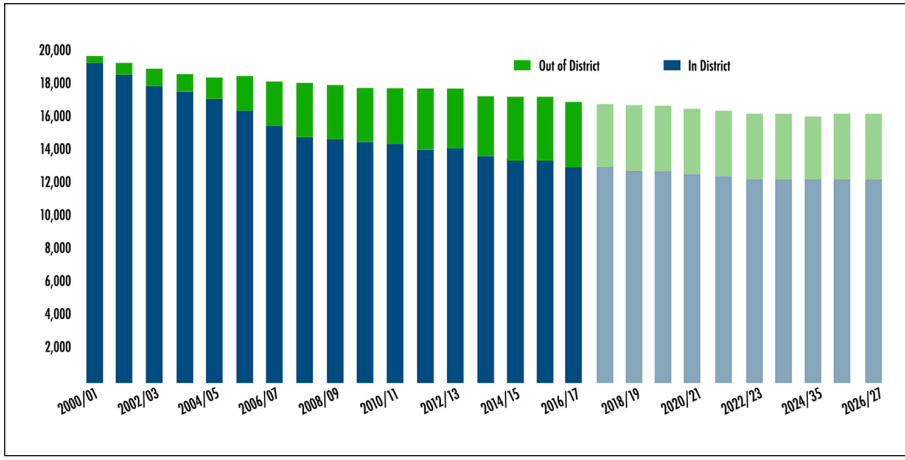

Figure 1. Total district enrollment, 2000–2017, and projected enrollment, 2018–2027.

of the future. The design process served as a way to break away from the traditional "grammar of schooling" (Tyack & Tobin, 1994) in a system relatively unaccustomed to radical change. The core tension in the case is between the abductive, open-ended, design-based approach and the traditional deductive or inductive approaches to managing change in schools. As part of this core tension, the case illustrates the challenges of (a) maintaining fidelity to the design process within a range of constraints (including but not limited to time and resources) and (b) rapidly and iteratively prototyping and testing a new school model within an existing educational ecosystem.

Context/Learning and Teaching Setting

This case study involves two institutions located in a large metropolitan area in the western United States. The first, Kenning School District, includes 25 schools (serving approximately 17,000 K–8 students) in a relatively affluent suburban area characterized by an aging population and declining enrollment (see Figure 1). Kenning, like many other districts, faces competition for students from charter schools and other neighboring public schools, as statewide open-enrollment policies allow students to cross district lines. The state also faces significant teacher shortages, and although this has not had a substantial impact on Kenning, district administrators have noted the trend with concern. Finally, teacher-led activism (characterized by the state's Red for Ed movement) has emerged in this state, aligned with other nationwide trends.

The second institution is a prominent college of teacher education, located within 25 miles of the school district. The college, which graduates the state's largest number of credentialed teachers, has articulated an explicit mission to improve education outcomes and the civic and economic health of its surrounding communities. Consistent with this, the college created a Design Initiatives (DI) team tasked with helping local

school communities reimagine and redesign PK–12 schools and school systems, using design as its primary theoretical and operational approach.

For the DI team, design and design thinking provided a foundational set of mindsets and tools with which to support partners' efforts to innovate and create change. In the eyes of college leadership and the DI team, the design process represented a human-centered approach that might address what Rittel and Webber (1973) have referred to as "wicked problems." As Zafeirakopoulos and van der Bijl-Brouwer (2018) have noted, wicked problems typically do not yield to approaches that attempt to apply existing solutions. Rather, they suggest that working to ameliorate such problems may require *reframing* them. In contributions to design literature (Dalsgaard, 2014; Schell, 2018; Steen, 2013), authors have noted that while Rittel and Webber originally framed wicked problems as pertaining to the realm of social policy and decision-making, they pertain to a range of domains within design as well. This is because the skills, mindsets, and tools used to solve wicked or ill-structured problems (Simon, 1973/2019) are fundamental to design (Dorst, 2015). As such, the DI team sought to build and facilitate partnerships using design as a means of capacity-building and fostering innovative systems transformation with local school partners.

Case Narrative

Design Challenge and Main Stakeholders

The school–university design project partnership originated with conversations between Kenning Superintendent Jill Varney, who joined the district in 2016, and Dean Karen Bowden, who arrived at the college the same year. During early conversations, it became clear that Kenning district leaders wanted to create a new model for school—a "school of the future." The design thinking approach that the college's DI team proposed taking resonated with the district team, who were eager to find ways to be innovative given the competitive context and their desire to better meet the needs of students, educators, and families. District leaders embraced the concept of designing a learning experience from scratch rather than making smaller iterations on existing environments, which is a more common approach to educational change. They felt that being able to dream big would allow educators to consider possibilities that would not naturally occur within the usual decision-making processes and mindsets that existed within the district.

The school design project, although a new project for both organizations, built on relationships that had existed prior to this project, particularly around placing teacher candidates within the district. This new partnership trajectory started with the signing of an MOU (memorandum of understanding), in fall 2017, by district and university leaders. The MOU outlined anticipated project outcomes as well as corresponding responsibilities for each group. Specifically, the project focused on developing a design for a new school model, with two central goals:

1. Engage students in a dynamic learning environment that promotes academic excellence and prepares them to be innovators and leaders of tomorrow; and

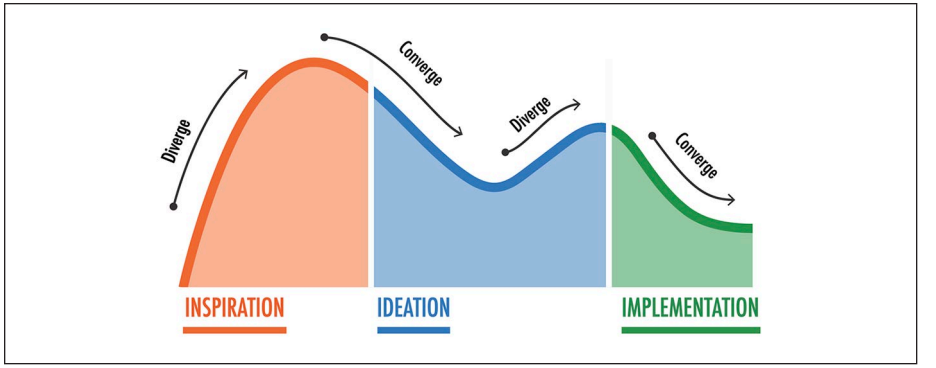

Figure 2. Human-centered design process and model (based on IDEO.org's human-centered design process).

2. Deploy educators in nontraditional ways by creating new roles and staffing structures to attract and retain high-quality staff and reinvigorate the teaching profession.

From the outset, the DI team from the college of education assumed responsibility for establishing the initial design brief, as well as overall project scope and management. A steering committee was formed with three representatives from each group. Assistant Superintendent Lorraine Thomas acted as project lead for the district, and Design Strategist Melissa Woodson was the lead for the college's DI team. Lorraine and Melissa established weekly phone calls to co-manage the project and developed shared communication protocols.

Design Intervention and Process

As the project began, Melissa and her DI team colleagues explored ways to structure the design process. Although the project was led collaboratively with the district, the role of guiding and facilitating the process was the DI team's responsibility. In this, they were inspired by a range of design-based approaches, including those from the Stanford d.school, IDEO.org, Heller (2018), and Liedtka et al. (2017). These approaches were adapted because of their broadly shared, open-source appeal, and because of their derivation from practitioner-scholars in peer higher education institutions. While the DI team has since developed its own design framework and tool set, this project represented one of its earliest efforts, and as such, the team adapted widely shared materials from thought leaders in the field.

Most notably, the DI team adapted the three-phase model from IDEO.org's *Design Kit* to serve as the baseline for project phases. These phases, as shown in Figure 2, consist of *Inspiration*, *Ideation*, and *Implementation*. This structure provided guidance for the design thinking approach and aligned with a set of tools and protocols the team

could use to facilitate the design process. During the Inspiration phase, designers seek to more deeply understand the problem, gathering ideas and insights as experienced by the stakeholders themselves. As a critical component of design thinking, understanding how users are affected enables designers to better frame problems and possible solutions (Diefenthaler et al., 2017; Dorst, 2015). During the Ideation phase, designers create problem frames and generate possible solutions. During the Implementation phase, designers begin to prototype small-scale iterations of the proposed solutions, seeking targeted feedback from stakeholders. In this way, design thinking represents an iterative approach to real-world experimentation, rather than analytical or historical thinking (Liedtka et al., 2017).

Inspiration

In late fall 2017, Lorraine, Melissa, and the steering committee invited a range of district-related stakeholders to a kick-off event to introduce the project goals and invite attendees to join the design journey as part of the core design team. The core design team was expected to meet monthly for a series of after-school sessions, with additional work occurring between these sessions. The resulting core design team comprised about 15 people, including teachers, principals, district leaders, and community members.

When the core design team began meeting in early 2018, they began the Inspiration phase with a focus on empathy-building and research. It quickly became evident that the time demands of design team meetings with assignments in between might bump up against participants' busy schedules. For example, when design team members were asked to spend a day shadowing a student at school to understand learners' lived experience, design team members responded enthusiastically. Completing the task, however, proved to be challenging for many because of workday time constraints. That said, those who completed the task found it insightful and shared their findings with the others, thus attempting a level of shared understanding.

As the Inspiration phase continued, and perhaps not surprisingly given the many demands on educators' time, participation at design sessions fluctuated. For a few design team members, consistent scheduling challenges led to a decision to leave the team, and district leaders invited new members to participate. With additional design team members joining midstream, the session facilitators made a concerted effort to bring new members up to speed with the larger group, both conceptually and procedurally, without significantly slowing the overall design process.

Ideation: Big Ideas

Despite these challenges, the design team progressed enough through the Inspiration phase to shift their focus to the Ideation phase in summer 2018. To begin ideation, Melissa and her teammates built on an idea they had seen during an out-of-state school visit—specifically, how that school's "design principles" acted as a north star for their work. The DI team facilitated an affinity diagram protocol, in which design team members individually wrote phrases and ideas, one per sticky note, to describe

their ultimate vision for the school. The whole group then organized the sticky notes into thematic groupings and created labels for each. Two team members took these ideas, synthesized them into a set of design principles, and subsequently shared them with the design team for revision. The final design principles (Table 1) acted as a foundational document and anchored the team as they further developed their ideas.

At a design charrette later that summer, additional school community members joined the core design team for a full day devoted to ideation. The DI team led activities framed around the design principles, which helped ensure that a broader set of community members could contribute their input in an aligned manner. Charrette participants worked with architects to draft learning spaces, used "role cards" to build teams with a variety of educator roles, and wrote "This I Believe" statements about the new school model.

Following the design charrette, the design team continued to meet for monthly sessions with a continued focus on ideation. Broad ideas needed to be developed into more detailed plans, and the core design team struggled to articulate actionable specifics. Melissa grappled with ways to push design team members in their thinking. At one session, design team members wrote mission statements using the frame, "We aim for x by doing y" and brainstormed local community partners who could enrich student learning, but the mission statements fell flat and the brainstorming lacked vitality without a clear context. Around this time, the idea of project-based learning (PBL) as an instructional approach emerged, and the design team members explored resources and videos to learn more. It remained unclear, however, precisely what role PBL would play in the eventual design.

Ideation: Building the Model

Throughout the first part of the Ideation phase described above, the steering committee met weekly to discuss the project's trajectory. The initial plan had envisioned a full-school launch in fall 2019, and with only a year to go, prototyping became an increasingly urgent topic of conversation. Early in the project, Melissa and Lorraine had anticipated that teachers on the core design team would test emerging ideas in their classrooms in short, rapid iterations. As ideation unfolded, however, two issues became apparent. First, because many of the ideas already existed in small pockets, it was possible that prototyping individual components would not provide much additional insight. Second, the true power of the emerging ideas was in how the components interacted with each other holistically, rather than in isolation, making the isolated prototyping of ideas relatively ineffectual.

The steering committee grappled with how to prototype and test the design team's ideas in a holistic, iterative manner within the existing educational ecosystem, and a new idea emerged: a small, pilot program to span the entire school year. This would allow the team to prototype ideas in an integrated way over an extended period of time. The steering committee worked with Superintendent Varney to develop a plan for a 2019–2020 pilot program as a school-within-a-school at an existing campus (see Figure 3 for a timeline of the revised process.)

Table 1. School Design Principles.

Principle	Description
Equity & inclusion	Students learn at a pace that fits their individual needs and explore their interests and passions. Educators recognize the value of having students from different backgrounds working together and employ a variety of approaches to accommodate diverse learners. Educators work to address social inequities, help all students reach their full potential, and support learners as they prepare for college entrance and completion.
Student-centered learning experiences	Students and educators work together to design their learning and make meaning of the world. Students develop questions they are hungry to answer, research the topics in class, present what they have learned, and reflect on the learning process. Together, students and teachers identify problems beyond the classroom and work collaboratively to develop possible solutions.
Educators as designers & facilitators	Educators collaboratively design curriculum and interdisciplinary projects, acting as guides who empower students as active researchers and problem-solvers. Educators engage in reflective practice, embracing the mindset that we are all learners.
Culture of community, care & collaboration	Our school community fosters positive relationships and social interactions. We value caring, trust, and mutual respect among students and adults. We embrace a growth mindset, challenging ourselves to take chances and learn from our mistakes. Through partnerships in our community, we address real-world problems and develop as leaders and productive global citizens.
Transformative learning spaces	We embrace innovative time structures and physical spaces that facilitate student movement, engagement, and collaboration. We embrace innovative staffing structures and student groupings that advance our goals of equity and individualization. We take chances on trying new structures and innovations, knowing that we will learn and adjust as we continue.

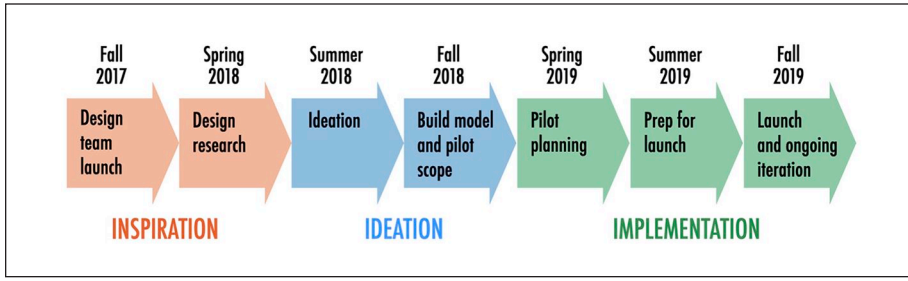

Figure 3. Design partnership timeline and scope.

Melissa and the DI team made a proposal for the next step: For the next design team session, small groups would build out more detailed descriptions of possible school models. Kenning leaders agreed. Bearing in mind the adage that constraints inspire creativity, the steering committee set broad guidelines for the challenge and extended an invitation via email, as follows:

> *During this Wednesday's design session, team members (that's you!) will build out learning community models. We want you to imagine*:
>
> - 90-100 students within an assigned age band grouping (K-2, 3-5 or 6-8).
> - A "master" teacher is part of the learning environment.
> - Students take state-mandated standardized tests. This is the only "requirement."
> - Typical time constraints, structures, and requirements do not exist.
> - We will ask you to address these "buckets" in your model: staffing, curriculum, operations, physical environment

During the next session, design team members leaned in. The room filled with a productive buzz of conversation as groups toggled between resources and their school designs, honing their ideas and making them more specific in nature. The session closed with groups sharing their proposed models, and Lorraine, Melissa, and the other steering committee members felt a renewed sense of momentum and hope.

When the steering committee debriefed, they decided that rather than holding design sessions through the end of the year as planned, it was time to transition the work to an implementation team that could move the work forward. It seemed the core design team had achieved as much specificity as they could. The steering committee met for a half-day retreat to comb through details, refine ideas, and synthesize themes, ultimately creating one pilot model.

As the core design team assembled in October 2018 for a final session, Lorraine presented the pilot model and shared her gratitude. Melissa led a discussion to reflect on the design process, and design team members voiced excitement about the model, relief that the plans were actually going to be put into action, and hope that the project could create positive change for education in the district (and hopefully beyond). Several people offered that they wished the design process had moved more quickly. Many talked about how refreshing it had been, even when they were tired from a day of work, to come to a space where they were encouraged to think creatively and without the usual constraints.

The prototype design shared with the core design team involved four key components: (a) a multi-age, heterogeneous cohort of 100 to 120 students in third, fourth and fifth grades; working within (b) an open, flexible physical environment to accommodate student movement and support a variety of student groupings; led by (c) a collaborative team of educators consisting of a lead Teacher Executive Designer, two certified teachers and three teacher candidates, who collectively design and facilitate (d) a learner-centered curriculum, with an emphasis on experiential learning through PBL.

Implementation: Pilot Planning

With the design team's work completed, Lorraine and Superintendent Varney shifted their focus to implementation, pulling in a variety of district leaders from various departments. The need to shift and stretch existing structures and policies to accommodate the new school model became quickly clear, in areas that included human resources, facilities, curriculum, marketing, and enrollment.

District leaders, with support from Melissa and the DI team, developed presentations to share the prototype program with the school district's governing board and the broader community. Communicating the goals and approach of the program proved challenging at times, and in many ways, the communication process itself turned out to be a prototyping period, with rapid iterations occurring throughout. Many of the iterations involved sharpening the message and proactively addressing concerns raised by members of the community. For instance, some community members thought the pilot model reduced teacher jobs, which led the district to carefully reword and clarify the descriptions of the educator roles. Several parents said that they hesitated to enroll their fifth-grade students in the program without a guarantee that a middle school program would be ready the following year. As a result, the district scaled back to Grades 3 and 4 for the initial pilot year. Finally, in spring 2019, the project was brought before the governing board, and the board granted approval for the pilot program for a period of three years.

After school board approval had been granted, the next step was hiring staff to lead and teach in the pilot program. In particular, the pilot model included a new teacher leader role, the Teacher Executive Designer, which required developing a new job description. Finding the right staff was challenging. Some district teachers, although enthusiastic about the model, were hesitant to join in the first year, citing the intense work that would be required of the pilot team. Over time, however, a strong team was hired, and educators spent the summer in intensive planning to prepare for the pilot's launch.

Implementation: The Launch

By the fall of 2019, the pieces were in place to launch the pilot program: a school within a school that strives to fulfill the two goals set forth at the beginning of the project to (a) engage students in a dynamic learning environment and (b) deploy educators in nontraditional ways by creating new roles and staffing structures.

The pilot's instructional model is built on experiential learning, with an emphasis on PBL and other inquiry-based approaches. Educators co-create interdisciplinary PBL units that emerge from student interests and align with state standards. The educator team has the autonomy to leverage district-adopted curricular resources selectively, choosing the resources that best align with the topics and standards being addressed.

In its first year, the pilot program includes 75 to 80 students in Grades 3 and 4, all of whom have elected to be part of the program. Rather than having one assigned teacher for the year, students benefit from a team of educators led by the Teacher Executive Designer, who is an experienced, highly effective, certified teacher. The core educator team includes two additional certified teachers, plus three teacher candidates (full-year, paid residents). Community educators with content area expertise act as additional part-time team members who contribute their expertise. For example, a mindfulness coach visits the learning environment three times weekly to work with students on mindfulness and other socioemotional and cognitive strategies. Other experts visit the school as volunteer guest speakers either in person or via technology to support students during PBL units.

The district undertook minor construction to create the pilot program learning space within an existing campus. The main learning space is composed of two large, open areas with operable walls. A makerspace with three-dimensional (3D) printers and other maker equipment sits at the center of the learning space with added windows to improve visibility. All spaces and furniture are flexible, allowing for varied uses during the learning day.

The pilot program follows a flexible schedule, although lunch, recess, and specials (e.g., music, physical education) are held at set times each day. The remainder of the schedule can be adjusted according to the needs of the learning community to accommodate activities or visiting experts.

The educator team views the structures and approaches they implement as an ongoing prototype, and they openly share this iterative approach with students and families. The team has tried multiple schedules and student groupings as they have calibrated what works best for students and what most effectively leverages team members' strengths. They have spent considerable time building their capacity in PBL approaches, both individually and as a team.

During the course of the pilot year, the team has increasingly moved toward personalization for students by creating "autonomy charts" and allowing students to determine the pace at which they work. Educators also use blended approaches in which they record mini-lessons that students can watch at home or at school, replaying content as needed. Whereas early in the school year, students mostly worked in a whole group format, by mid-spring, students were spread out around the space and worked more independently, with educators acting as guides on the side.

During the next school year, in line with the spirit of prototyping, some program design changes are planned. There will be about 120 students in Grades 3, 4, and 5, with new students entering mostly in Grade 3. The educator team will include four certified teachers in total (two of them novice teachers who were teacher candidates the previous year), and two new teacher candidate residents will join the team.

Throughout the iterations, the Teacher Executive Designer and the project steering committee have returned to the core design principles again and again as their "north star" for what the design team envisioned. Conversations about possible program expansion are in progress.

Reflection and Teaching Notes

This case study is consistent with current trends in educational design, where educators and educational institutions use iterative, collaborative, action-oriented methods for creative problem solving in educational contexts (Diefenthaler et al., 2017; Henriksen et al., 2017; Jordan, 2016). Underlying this trend is the idea that design-based methods and mindsets are well-suited to help people address complex, ambiguous problems in life and education (Buchanan, 1992; Dorst, 2015). Thus, educational practitioners and theorists are exploring the ways in which educators can embrace thinking and acting like designers to develop meaningful, rich educational experiences for students (Goldman & Kabayadondo, 2017; Jordan, 2016) and/or to catalyze systemic change within their institutions.

Issue 1: Design Efficacy

A first component in this case relates to the inherent challenge of helping nondesigners orient and adapt their skills to this new, open-ended, often ambiguous process. In this case study, both the steering committee and design team members were relatively new to open-ended, design-based processes, which limited their ability to utilize design-based tools fluently. This has been described as being design thinking's "pedagogy problem" (Schell, 2018): that is, the difficulty of rapidly training those not formally trained in design-based approaches to use design theories, processes, and practices in sustainable and transformative ways. Schell argues that these are not flaws inherent in the framework, but rather a consequence of the significant time and practice required for building fluency and skill in implementing design mindsets and tools.

Issue 2: Challenging the Grammar of Schooling

A second component of this case is that the partners used design-based approaches to challenge the existing "grammar of schooling," defined as the "regular structures and rules that organize the work of instruction" (Tyack & Tobin, 1994). Examples of this grammar include standardized organizational practices like sorting students into age-based grade cohorts, organizing learning by content area, and structuring time according to bell schedules. Tyack and Cuban (1995) note that many features of this "grammar" have remained remarkably sticky in public schools, sometimes dating back to the beginning of the 20th century, despite various attempts to alter it.

One of the key challenges to this process is the fact that many of these features of the grammar of schooling have seemingly become taken for granted as inherent to schooling itself, often making it difficult to even see options that could be changed. Hofstadter (1985) writes of creativity as being a process of developing "variations on a theme" where the key factor is to be able to see possibilities for change even in contexts where things have been taken for granted. For instance, an important aspect of the grammar of schooling is the breaking up of the day along disciplinary lines for

learners to reach specific understanding of ideas and concepts in a lock-step manner. In this case, the educator team, several of whom have taught for years in more traditional settings, proactively use the design principles to help guide their instructional decisions to keep from defaulting to old ways of teaching and doing.

Throughout the design process, the open-ended, abductive nature of design often pushed against the boundaries of the normative grammar of schooling. An important part of the design process was to reveal these hidden assumptions and see them as opportunities to create new structures and possibilities. This was not always successful, as some of the ideas that emerged conflicted with existing, often external, constraints and systems. For example, in one design session, a group proposed that students spend three days each week on the school campus and two days in community-based apprenticeships. Despite support from other team members, this idea did not progress due to state requirements for instructional minutes and seat time. Nonetheless, the prototype design did break away from some deeply rooted, normative school practices by embracing multi-age student groupings, an educator team collaboratively supporting students, and more fluid use of time and space. These fundamental shifts may have been more difficult to move forward, or perhaps would never have been considered, with a more traditional approach to school change.

Questions to Consider/Learning and Teaching Activities

1. How does a design-based approach to organizational change differ from other approaches to educational change? What are the potential benefits of design-based approaches, and what are their barriers and limitations?
2. How do we support people in thinking differently about teaching and learning when it is difficult to break away from commonly held assumptions about what school is (i.e., the grammar of schooling)?
3. Imagine you are on the steering committee charged with constituting a design team for this project. Who will you include, and what will their roles be? How will you address having some members who are unable to participate fully?
4. Imagine you are in Melissa's role leading the DI team, and you are working to develop a project timeline. During which parts of the design process would you spend more or less time than described in this case study? How would you structure the design sessions?
5. Building empathy is often an entry point for design work. Given the constraints of time, how could you engage the design team in gathering and understanding a range of stakeholder perspectives?
6. During the design process, design team members were passionate about their big ideas but sometimes struggled to narrow their ideas into actionable designs. What other approaches might you have used to support the core design team in becoming more specific?
7. Given that Melissa and her team were often challenged to "manage without authority" with respect to the district partners, what might be some of the pros and cons to having an external partner facilitate the design project?

8. What are some ways to prototype something as large as a school without actually launching a whole school? What might you have done differently for the prototyping phase as compared with how it played out in this case?
9. At the last design session, many team members said that because the design process was long, it seemed like their ideas might never actually be put into action. Is the longer timeline a benefit or detractor of this design process? Why?

Acknowledgments

We would like to thank our district partners, the design team, and the funders who supported this work.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Benjamin S. Scragg https://orcid.org/0000-0002-3265-0484

References

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, *8*(2), 5–21.

Dalsgaard, P. (2014). Pragmatism and design thinking. *International Journal of Design*, *8*(1), 143–155.

Diefenthaler, A., Moorhead, L., Speicher, S., Bear, C., & Cerminaro, D. (2017). *Thinking & acting like a designer: How design thinking supports innovation in K-12 education* (WISE & IDEO, Eds.). https://www.wise-qatar.org/2017-wise-research-design-thinking/

Dorst, K. (2015). Frame creation and design in the expanded field. *She Ji: The Journal of Design, Economics, and Innovation*, *1*(1), 22–33.

Goldman, S., & Kabayadondo, Z. (2017). Taking design thinking to school: How the technology of design can transform teachers, learners and classrooms. In S. Goldman & Z. Kabayadondo (Eds.), *Taking design thinking to school: How the technology of design can transform teachers, learners and classrooms* (pp. 3–19). Routledge.

Heller, C. (2018). *The intergalactic design guide: Harnessing the creative potential of social design*. Island Press.

Henriksen, D., Richardson, C., & Mehta, R. (2017). Design thinking: A creative approach to educational problems of practice. *Thinking Skills and Creativity*, *26*, 140–153.

Hofstadter, D. R. (1985). *Metamagical themas: Questing for the essence of mind and pattern*. Basic Books.

Jordan, M. E. (2016). Teaching as designing: Preparing pre-service teachers for adaptive teaching. *Theory Into Practice*, *55*, 197–206.

Liedtka, J., Salzman, R., & Azer, D. (2017). *Design thinking for the greater good: Innovation in the social sector*. Columbia University Press.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, *4*(2), 155–169.

Schell, J. E. (2018). *Design thinking has a pedagogy problem . . . and a way forward*. 2018 Journal of Design and Creative Technologies (digital). https://designcreativetech.utexas.edu/2018-journal-design-creative-technologies

Simon, H. A. (2019). *The sciences of the artificial*. MIT Press. (Original work published 1973).

Steen, M. (2013). Co-design as a process of joint inquiry and imagination. *Design Issues*, *29*(2), 16–28.

Tyack, D. B., & Cuban, L. (1995). *Tinkering toward utopia*. Harvard University Press.

Tyack, D. B., & Tobin, W. (1994). The "grammar" of schooling: Why has it been so hard to change? *American Educational Research Journal*, *31*(3), 453–479.

Zafeirakopoulos, M., & van der Bijl-Brouwer, M. (2018). Exploring the transdisciplinary learning experiences of innovation professionals. *Technology Innovation Management Review*, *8*(8), 50–59.

Author Biographies

Lisa G. Wyatt is a senior program strategist, Next Education Workforce, in the Mary Lou Fulton Teachers College, Arizona State University.

Benjamin S. Scragg is the director of design initiatives in the Office of Scholarship and Innovation, Mary Lou Fulton Teachers College, Arizona State University.

Jennifer Y. G. Stein is the director of strategy for learning futures in the Office of Scholarship and Innovation, Mary Lou Fulton Teachers College, Arizona State University.

Punya Mishra is the associate dean of scholarship and innovation, Mary Lou Fulton Teachers College, Arizona State University.